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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 96

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NEW ACTIVITIES, MISCELLANEOUS

ERRORS OF METHODS FOR DETERMINING SIGNAL-NOISE PARAMETER OF IONOSPHERIC SIGNAL

VOLOGDIN, A. G., ZHURAVLEV, S. V. and MIRKOTAN, S. F.

[Abstract] The signal-noise parameter of returning ionospheric radio signals, namely the power ratio of their coherent and scattered components, is evaluated by various methods. One method is based on the Rice model and involves experimental determination of the ratio of signal envelope moments squared, this ratio being functionally related to the signal-noise parameter. Two other methods involve recording one of the two signal components in phase quadrature $E_i(t)$ (i = cos,sin) and utilize the property of such signals to experience a certain Doppler shift of their frequency spectrum upon reflection. The first of these methods further utilizes the functional relation between the signal-to-noise parameter and kurtosis of the $E_i(t)$ process. The second of these methods takes into account the fact that the signal-to-noise parameter depends

on the roots v_n of characteristic functions $\theta_i(v)$ and on the moment $\overline{E_i^2(t)}$, if

such roots exist and $\overline{E_i^2}v_n^2 \geq \mu_n^2/2$ (μ_n - roots of zero-order Bessel function). A comparative error analysis of all three methods, considering calculation errors attributable to the form of the functional relations as well as measurement errors attributable to the statistical characteristics of the signal-to-noise parameter such as the form of its probability density distribution, indicates that the last two methods are more advantageous and especially so when the signal-to-noise parameter is close to but smaller than unity. Figures 2; references: 6 Russian.
[295-2415]

1

EFFICIENCY OF SMALL RECEIVER ANTENNAS WITH AMPLIFIERS

KONTOROVICH, M. I. and LYAPUNOVA, N. M.

[Abstract] "Transistorization" of receiver antennas has not necessarily
resulted in a small antenna with performance characteristics equal to those of
large ones, but it appears feasible to produce a rather efficient small
antenna for operation with a standard amplifier within the frequency band of
the latter. It also appears feasible to increase the sensitivity of such an
antenna by matching the latter with respect to noise without altering the
receiver input circuit, and to decrease the antenna effect of feeder lines.
Here these possibilities and the performance of such an antenna are analyzed
on basis of the equivalent circuit. An "active" antenna is considered, con-
sisting of a passive array (where the incoming field induces an emf) and an
active-element amplifier (almost fully immune to action of the external field)
coupled through a matching four-pole network. The signal-to-noise power ratio
of this system is regarded as the sum of four components accounting, respec-
tively, for interference from space, noise in antenna, feeder, tuning devices,
and noise in first amplifier stage. All these noise sources are assumed to be
statistically independent. Noise power is defined as the modulus of the corres-
ponding voltage squared. All these components, proportional to the frequency
band, are evaluated on the basis of corresponding equivalent voltage genera-
tors. Typical numerical results are shown applicable to linear systems with-
out frequency conversions operating in the optimum mode. Figures 4; refer-
ences 5: 2 Russian, 3 Western (1 in translation).
[295-2415]

SPECIFICS OF FOCUSING METHOD FOR MEASUREMENT OF RADIATION PATTERNS OF
PLANE PHASED ANTENNA ARRAYS

KINBER, B. Ye., ANYUTIN, A. P. and MARTYNOV, A. M.

[Abstract] Measurement of the radiation pattern of plane (two-dimensional)
phased antenna arrays in the far-field zone by the focusing method is considered.
This method involves a special additional phasing of currents in all elements of
the array so that their radiation fields become synphasal in a given point at
a finite distance from the antenna array. The limitations of this method are
examined on basis of its specifics, namely the field distribution in the focal
spot and the differences between the latter and the radiation pattern. General
calculations based on intersection of the focal spot by a spherical surface,
with an appropriate Taylor series expansion and subsequent change of variables
for the far-field approximation, and calculations for an antenna array with
circular aperture indicate that the method yields correct results independent
of the α/λ ratio (2α- characteristic dimension of antenna array, λ- wavelength)
at distances beyond $(3-4)\alpha$ from the antenna array. Focusing at distances
closer than that will result in compounding of focusing errors as well as of
amplitude and polarization errors. Figures 4; references 7: 5 Russian,
2 Western (1 in translation).
[282-2415]

RESOLVING POWER OF LATERAL-SCAN RADAR STATIONS WITH UNFOCUSED SYNTHESIZED
ANTENNAS

NARYSHKIN, A. K.

[Abstract] The maximum linear azimuthal resolving power of a lateral-scan
radar station with unfocused synthesized antennas is $\delta y_{min} = \sqrt{0.5\lambda R_0}$ (λ -
wavelength, R_0 - slant range of object), while the dimension of the phantom
aperture is similarly $L_{max} = \sqrt{0.5\lambda R_0}$. The apparent paradox in the resulting
equality $L_{max} = \delta y_{min}$, namely that an increase of resolving power, i.e., a
decrease of δy_{min} would require a decrease of phantom aperture, is cleared by
considering that L_{max} can be decreased only by decreasing the wavelength λ (R_0
is an uncontrollable quantity) and thus improving the resolution. Further
calculations based on optimizing the phantom aperture for maximum resolving
power yield the relation $\delta y_{min} = \sqrt{2\lambda R_0}$. Figures 1; references: 1 Russian.
[282-2415]

PROBLEM OF RESOLUTION IN SYNTHESIS OF APERTURE IN SPACED SYSTEMS

KARAVAYEV, V. V. and SAZONOV, V. V.

[Abstract] Synthesis of the aperture in spaced radar systems is considered
from the standpoint of attainable resolution. Calculations are based on the
indeterminacy function for an arbitrarily wide spacing of receivers and trans-
mitter. In the case of active radar this function is equal to the normalized
square of the modulus of the scalar product of two signals, the signal which
would appear at the detector input without noise and the identical signal
shifted along the coordinate of any signal identifying parameter. In the case
of passive radar this function is equal to the mean square of the modulus of
the output signal from the optimum detector, the latter having been tuned to
any value of the signal identifying parameter with respect to which the signal
appears detuned at the detector input. In a typical application, to synthesis
in a direction normal to the plane of two receivers and a moving point object,
the resolution in this direction is calculated and found to be maximum when
the vector of the object's trajectory is also normal to that plane.
Figures 2; references 3: 2 Russian, 1 Western (in translation).
[282-2415]

LOW-FREQUENCY RESONANCE-TYPE SOUND ABSORBERS

INDLIN, Yu. A. and KOZLOV, Yu. Ya., All-Union Scientific Research Institute of Cinematography

[Abstract] A resonance-type sound absorber is considered which does not require porous material in the resonator cavity but instead utilizes air friction in the resonator throat for full absorption at resonance frequency. The resonator is formed by a screen mesh in front of a solid wall. The holes in the screen, the resonator throats, are cylindrical in shape with a length equal to the screen thickness. The performance of such a device is analyzed on the basis of the mass-spring analog, air in the throats representing the mass and air in the cavity representing the spring, with losses caused by air friction in the throats representing a resistance which at resonance frequency is equal to the characteristic impedance of air. The fundamental relation for the resonance frequency establishes the necessary volume of the cavity and mechanical admittance of the throat array in terms of their respective geometrical dimensions. An important advantage of this device is the small cavity volume required even for low-frequency sound. Experimental data have been obtained using a solid screen with a single equivalent hole, by varying (gradually increasing) the hole diameter or the distance from screen to wall, at various sound levels and with overdamping or underdamping. On the basis of theoretical relations and experimental curves the optimum design parameters can be determined for this absorber which will have a narrow absorption band and minimum additional losses (resistance) at the low frequencies to which it is tuned. Figures 8; references: 4 Russian.
[297-2415]

TELEVISION SYSTEMS WITH HOLOGRAPHIC DATA STORAGE FOR IMAGE TRANSMISSION

BIBIKOV, V. A., VAGIN, L. N., VOROB'YEV, S. P. and SVETLITSKIY, E. S.

[Abstract] Use of a television system for transmission of holographic data directly from holograms and their microstructures is not yet feasible, but

transmission of data such as the image of a document page already restored from a hologram is. The advantages are less severe resolution requirements and two-dimensionality of the object not requiring storage of volume data. The system includes a laser beam which restores the image from a hologram and an objective which transfers the image onto the vidicon target in the transmitter camera. Amplified video signals travel along the communication line to the television receiver, where the picture of the document page appears on the kinescope screen. The frequency range of video signals extends from 50 Hz to 21 MHz. The upper limit is based on a 3:4 frame format with 1575 resolution lines and 50 fields/s. The contrast sensitivity of the eye as well as loss of image elements during return strokes of line sweep and frame sweep are also taken into account. The electronic equipment for this application consists of conventional components contained in three modules. The transmitter camera contains an LI418 vidicon with focusing-deflecting system, a video preamplifier, and a black-out pulse shaper. The vidicon control module contains stabilized voltage supplies for the vidicon electrodes, two sweep generators, voltage supplies for the sweep generators, and a focusing-system stabilizer. The video control module contains a 35LK4B kinescope, a kinescope sweep generator, a sync generator, an intermediate video amplifier, a terminal video amplifier, and voltage supplies. The vidicon field is 15x20 mm^2 large, the kinescope screen is 240x215 mm^2 large, the frame frequency is 25 Hz, and there are 8 reproducible brightness levels. The system has been tested experimentally for modulation characteristics, namely dependence of percentage modulation on line and vertical space frequency. The maximum capacity of a document page is 900 symbols with excellent readability (50% modulation) and 3500 symbols with passable readability (25% modulation). For transmission of pages with up to 8000 symbols, a page is read in parts and each part is magnified by electrical means. Figures 6; references: 3 Russian.
[297-2415]

IMPROVED SYSTEM FOR TRANSMISSION OF ADDITIONAL DATA OVER TELEVISION CHANNELS

MAMEDOV, I. R. and NOVAKOVSKIY, S. V., Institute of Electrical Engineering of Communications, Moscow

[Abstract] Modification of the television signal has been proposed in order for transmission of additional data during the active field period. This is made possible by automatic seeking out and multiplexing of lines with low information content or "dead" ones at the sending end. As such lines qualify those within the boundaries of which the magnitude of the image signal does not vary. The line seeking and multiplexing equipment on the transmitter side with the television signal source includes a differentiator-amplifier, a storing device, two pulse generators with a "black out" input terminal and an "additional data" input terminal respectively, a buffer memory, two gates, one with a "subcarrier oscillation" input terminal, two adders, a modulated stage, two delay lines, and an output stage. The receiver at the other end is followed

by a selector, a restorer, a discriminator, a switch, and a terminal stage. Sound tracking is, furthermore, made possible by using the radio transmitter of image signals in a vacant radio channel or by high-speed recording of the sound track signal with address on separate tracks of the video disk and playing it back at normal speed on the receiver side. Figures 2; references 3: 2 Russian, 1 Western.
[297-2415]

HEAT CALCULATIONS FOR COAXIAL CABLE TRANSMITTING SINGLE POWER PULSES

GORDODETSKAYA, N. I., engineer, PUSHKOV, N. V., candidate of technical sciences, and SOLOMONIK, S. S., candidate of technical sciences, Special Design Office of Cable Industry

[Abstract] The thermal performance of a coaxial cable transmitting electric energy in single pulses is analyzed, such a mode of transmission being characterized by intervals between pulses sufficiently long for all processes begun during one pulse to decay completely before the next one. Joule-effect heating of the cable surface is calculated on a basis of the fundamental equation disregarding heat conduction but taking into account the temperature dependence of electrical conductivity as well as the effect of stranding and also including the relation between thermal and electrical skin depths. Cooling of the cable surface is calculated on the basis of two differential equations describing heat transfer from conductor and sleeving through insulation and sheath to ambient medium, in accordance with the thermal equivalent series circuit. Results are shown, namely formulas for skin depths and heating curves in terms of maximum temperature rise as a function of current amplitude, for five pulses to a matching load: trapezoidal, triangular, exponential rise + exponential fall, campanulate, and sinusoidal with amplitude decrement. Cooling curves, conductor and sleeving temperatures as functions of time, are also shown on the basis of data on polyethylene insulation and an empirically established exponential dependence of the heat transfer coefficient on the outside cable diameter. Figures 5; tables 1; references 3: 1 Russian, 2 Western (in translation).
[294-2415]

FIBER-OPTICAL TRANSDUCERS OF LINEAR DISPLACEMENTS

MOISEYEV, V. V., POTAPOV, V. T., SOKOLOVSKIY, A. A. and SVIRIDOV, V. A.

[Abstract] Two simple and accurate transducers of small linear displacement
which use fiber optics are described. One has been designed on the basis of
the dependence of the power input to a two-layer fiber on the distance from the
fiber entrance to light source. This transducer has maximum sensitivity and
linearity when the radius of the Lambert light source (light-emitting diode)
is equal to the radius of the conductor. The other transducer has been designed
with reflection of the light leaving the fiber back into the fiber. Both the
reflected power and the distance from fiber exit to reflecting surface are
measured. A uniform power distribution over modes at the fiber exit indicates
a specular reflecting surface perpendicular to the fiber axis, in which case
the reflected power depends on the reflection coefficient and the surface rough-
ness. Both parameters are controllable and, since with powerful light sources
such as lasers a uniform power distribution is attainable even at the exit
of long fibers, this type of transducer is more sensitive than the first one.
This has been confirmed experimentally. Figures 2; references 2: 1 Russian,
1 Western.
[295-2415]

NORMALIZED CUTOFF FREQUENCIES FOR OPTICAL FIBERS WITH PARABOLIC PERMITTIVITY
PROFILE IN CORE

GORDON, G. I.

[Abstract] The normalized cutoff frequencies and the total number of guide
natural modes have been determined for optical fibers with a parabolic permit-
tivity profile in the core. The results are based on an approximation appli-
cable to linearly polarized modes and on relations derived from solutions to
the problem for the general case of optical fibers with a permittivity gradient,
solutions obtained by the method of perturbations, the variational method, and
numerical methods using a digital computer. Tables 3; references: 11 Western
(1 in translation).
[282-2415]

OUTPUT SIGNAL FROM LIGHT GUIDE ACOUSTOOPTIC AUTOCORRELATOR FOR LINEARLY
FREQUENCY-MODULATED SIGNALS

VASIL'YEV, Yu. G.

[Abstract] An acoustooptic autocorrelator of linearly frequency-modulated
signals is described in which the acoustooptic light modulator receives signals
from a laser through a condensing lens and a collimating lens and transmits
them to a photoreceiver through an integrating lens and a light guide. The
performance of this device is analyzed in terms of its space-time response
characteristics and output signal parameters. Relations are established for
the length of the piezoceramic transducer L and the wave parameter of the

modulator $Q = \frac{\pi \lambda L}{\Delta 2}$ (λ- wavelength of light, Δ - wavelength of ultrasound), tak-
ing into account the Bragg diffraction criterion, which determine the conditions
for optimum performance in terms of allowable widening of output signal.
Figures 4; references 11: 8 Russian, 3 Western (1 in translation).
[295-2415]

VELURE-EFFECT IN MAGNETIC TAPES

NEMTSOVA, S. R. and OLEFIRENKO, P. P., All-Union Scientific Research Institute
of Television and Radio Broadcasting

[Abstract] A velure-effect, namely different sensitivity levels in the forward
direction and in the reverse direction, has been revealed in some magnetic
tapes (PER 528 tape produced by Agfa-Gevaert, FRG) by electroacoustic measure-
ments at frequencies of 1.0 and 16 kHz with the tape traveling at a velocity
of 38.1 cm/s. This effect occurs only in the recording mode with both record-
ing in one direction only and playback in both. The magnitude of this effect,
which can appreciably degrade the quality of phonograms, depends largely on
the high-frequency magnetizing current and on the recording wavelength,
increasing as the former increases and as the latter decreases. The mechanism
of this effect, involving essentially an asymmetry of the recording process,
can be explained on the basis of a model where the preferred orientation of
magnetic particles is not in the plane of the tape but at some angle to it.
Two possible variants of this model have the angle between preferred orienta-
tion of particles and direction of the orienting magnetic field, respectively,
acute or obtuse, each corresponding to quasi-ideal magnetization with the tape
traveling in the forward direction and in the reverse direction respectively.
Figures 5; references 4: 2 Russian, 1 Western (in translation), 1 Inter-
national.
[297-2415]

CORRECTION OF COLOR-SATURATION DISTORTIONS IN ELECTRONIC MASKING

KUZNETSOVA, Ye. M., Moscow Scientific Research Institute of Television

[Abstract] Light correction by means of a logarithmic masking matrix is effectively used for improvement of the quality of movie teletransmission in color. A few frames are inevitably produced with errors in brightness grada-tion and, during electronic masking, these frames will be reproduced with excessive saturation. Analysis of the spectral absorption characteristics of the three dyes (yellow, purple, blue) on the positive, taking into account the linear dependence of monochromatic optical density on dye concentration in accordance with the Bouguer-Beer law, and analysis of video signals in color-separated channels reveals that the main cause of oversaturation are sporadic deviations from the linear dependence of the difference between the logarithms of two video signals on the difference between concentrations of the corre-sponding dyes. This conclusion suggests means of eliminating distortions caused by oversaturation, namely by appropriate modification of the corrective devices in the video processing channel of the movie teletransmission system. Proper correction includes that of parasitic absorption by other than a given dye and correction of the spectral characteristics of the movie televising camera in accordance with the photographic reproduction characteristics, after the brightness curve of the original has been transformed into an equivalent brightness curve of the positive. Figures 6; references 7: 6 Russian, 1 Western.
[297-2415]

EXPERIENCE AT LENINGRAD DUPLICATING FACTORY IN MASS PRODUCTION OF FILM COPIES BY PRINTING FROM NEGATIVES

PETRENKO, YURIY ALEKSEYEVICH, chief engineer, Leningrad duplicating factory

[Abstract] In an interview with correspondent Ya. I. Butovskiy of TEKHNIKA KINO I TELEVIDENIYA, Yu. A. Petrenko discusses problems, experience and achievements in mass production of film copies at the Leningrad duplicating factory. Both yield and quality have improved since 1976, when copies of the film "Queen of Spades" were produced. Already up to 500 copies of a film could be produced in early 1982, after multistep processing (printing of inter-mediate positive--printing of countertype--mass printing) had been replaced by printing directly from the negative. This was achieved economically, without extra costs associated with restoration of the negative. This was achieved with maintenance of high quality by special selection and adaptation of equip-ment, improving the technological process, conditioning the work area, and improving the skills of operators. Capabilities have been extended, namely

"footage" (up to 10,000 m) and speed (up to 4400 m/h with Bell-Howell copier) as well as the number of passes between overhauls and negative restoration (up to 15). Two major problems still requiring attention and not solvable in the factory alone are quality of the source material, especially physico-mechanical and photographical characteristics of the negative, and the psychological burden on operators responsible for producing high-quality copy directly from the negative under difficult conditions such as frequent changes in lighting. Past achievements were made possible and further planning will depend on a large staff including several pioneers: mechanic E. Ye. Kuz/min, assembler-woman A. V. Mosur, copier-woman T. S. Gordiyenko and V. M. Nikiforova, lighting adjuster L. N. Iodast, master technician N. A. Solov'yeva, and senior engineer-technologist Ye. P. Gerasimova.
[297-2415]

PROBLEMS IN ENSURING PRODUCT RELIABILITY IN MOTION PICTURE TECHNOLOGY

LUK'YANOV, A. D. and FAL'SKIY, V. V.

[Abstract] For predicting the reliability of products in the motion picture industry, designers as well as quality inspectors must have reliable data on the life and failure rate of product components. So far only data for electrical and radio components are available, with none for the mechanical components and subassemblies. Problems arise here from the fact that statistical data on the total product in operation do not suffice, while testing individual components and subassemblies at the various enterprises would not be economical. It is proposed therefore that a central testing station be set up at the headquarters of the industry, where highly skilled staff and highly advanced equipment are already available. There, with the collaboration of individual enterprises, all necessary tests could be performed systematically and the resulting information compiled and documented in a standard format for use where needed. Test chambers for determining the effect of climatic conditions and mechanical actions deserve particular attention. Such chambers with appurtenances should be made available during the 11th Five Year Plan period.
[297-2415]

ACCOUNTING FOR ENERGY RELATIONS IN MODELS OF RADIOELECTRONIC CIRCUITS

BARDILA, T. I. and SHAPOVALOV, Yu. I.

[Abstract] Inclusion of energy parameters in models of radioelectronic circuits
makes it possible to combine electrical and structural design calculations,
power being especially important with regard to operating temperature and
physical dimensions. This is demonstrated on circuits with external driving
voltage and current signals, without internal a.c. sources. Calculations are
shown specifically for a two-pole network between two nodes where voltages and
currents consist of direct and alternating components. The method can be
extended to three-pole and multipole networks, also to calculation of noise,
radiation, and other performance characteristics. Figures 1; references:
2 Russian.
[284-2415]

HIGH-SPEED HIGH-RESOLUTION DIGITAL FREQUENCY SYNTHESIZER

NAZARENKO, V. M., IL'INSKIY, I. V. and SHAKHTARIN, B. I.

[Abstract] Construction of a frequency synthesizer on the basis of phase-type
automatic frequency control with variable-ratio frequency division is described.
Frequency dividers with fractional variable ratio produce output oscillations
with poor spectral characteristics and require amplified filtration of sub-
harmonics of the reference frequency. Consequently, a second stage is added
instead for establishing a definite functional relation between any parameter
of the output oscillations or any synthesizer design parameter and the corres-
ponding oscillations from an auxiliary oscillator. The latter has been added
for obtaining the same ratio between instantaneous synthronized-oscillator and
reference-oscillator frequencies as would be with a fractional-variable-ratio
frequency dividing device. Implementation of this method with the period of

output oscillations as an operating parameter is shown, considering that the ratio of synchronized-oscillator frequency to reference-oscillator frequency is initially an improper fraction consisting of an integer and a proper fraction. This two-stage synthesizer consists of two phase detectors, two low-pass filters, two QRs-triggers with OR-gate outputs, two decoders, two coincidence circuits, and two adders with a register each. High reference frequency and absence of pulse width moudulation in the controlled oscillators make high speed of synthesizer operation easily attainable, the error signal requiring little filtration, while absence of pulse width modulation in the error signal contributes to a high resolution. Figures 2; references 3: 2 Russian, 1 Western.
[295-2415]

AUTOMATIC DETERMINATION OF PARAMETERS OF NONLINEAR DYNAMIC MODELS OF ACTIVE COMPONENTS OF AUTOMATED DESIGN SYSTEMS FOR RADIOELECTRONIC EQUIPMENT

ANISIMOV, V. I., MAKSIMOVICH, V. A. and RYNDIN, A. A.

[Abstract] The dynamic parameters of active components of radioelectronic apparatus are usually based on nonlinear models and determined experimentally through direct measurement. The process of their determination cannot be automated as long as instruments and procedures for determining each of them are different. Here a method is proposed which will make automation possible. It is based on utilizing the parameters of static nonlinear models of active components. These parameters can be determined from measurements at 10-30 MHz frequencies and small-signal relations. The method is demonstrated on a most common active element, namely a bipolar transistor and its Ebers-Moll model. The eight computation steps for an automated design system are: input of given data, calculation of current gain and interelectrode resistances, initial approximation of interelectrode capacitances, optimization by method of least squares, checking all collector voltages and current components and from here either returning to step 2 (if NO) or proceeding to factorial analysis of parameter matrices (if YES), approximating the dependence of interelectrode capacitances on operating conditions, and output of sought data. The method can be extended to automatic determination of statistical characteristics dynamic parameters and is applicable to models of active components which can be represented in form of separable equivalent circuits. Figures 1; references 5: 3 Russian, 2 Western (1 in translation).
[284-2415]

USE OF NONLINEAR FILTRATION IN STEREOMETRY

SPEKTOR, A. A.

[Abstract] Automation of stereoscopic measurements and image processing is con-
sidered, the main problem being randomness of the optical-density function of
the useful signal and presence of the usual fluctuation interference. Dynamic
programming is not entirely satisfactory from the standpoint of memory capacity
and response speed requirements. Here three algorithms of filtration are pro-
posed and applied, for illustration, to stereoscopic pairs. In the simplest
ideal case one of the two images is assumed to be noiseless, in the most typical
real case both images are noisy but with the same dispersion. Recurrence rela-
tions are derived for optimal nonlinear filtration on the basis of linear approx-
imation of the optical-density function. While a linear recursive filter is
faster, three-dimensional simultaneous filtration of the optical-density
function and its derivative as well as of the parallactic displacement is
optimal with respect to accuracy. Figures 5; references 9: 7 Russian, 2 Western
(in translation).
[282-2415]

STACK OF COMPUTER PROGRAMS (DEMAND) FOR CIRCUIT DESIGN AND OPTIMIZATION

IL'IN, V. N., BAKHOV, V. A., KAMNEVA, N. Yu., KOGAN, V. L. and KOTUL'SKIY, M. A.

[Abstract] A stack of computer programs is available for analysis, design and
optimization of pulse circuits and digital devices. The programs have a modu-
lar structure in order to facilitate interchangeability of decks and to provide
a broad base for many functional uses. They are constructed so as to ensure a
high degree of algorithmic reliability in terms of yielding correct solutions
for any circuit configuration, any characteristics of circuit components, and
any values of circuit parameters. The stack consists of five modules: 1) Ser-
vice data processing; 2) Calculation of static and one-step dynamic voltages
and currents; 3) Calculation of output parameters; 4) Analysis of output
parameters; and 5) Optimization. With this stack one can calculate the follow-
ing: 1) Steady-state performance on a basis of given or zero-value initial
conditions; 2) Transients on a basis of arbitrary initial conditions; 3) Set of
output parameters in single run; 4) Set of output parameters in several runs
with different values of input parameters each time; 5) Statistical character-
istics of output parameters with a histogram for each; 6) Dependence of output
parameters on temperature and other destabilizing factors; 7) Deterministically
optimum values of parameters according to any of seven applicable criteria and

by any of four available algorithms; 8) Statistically optimum parameter values according to reliability criterion or "percentage of acceptable yield" criterion; and 9) Optimum values of parameters in macromodel of a given circuit segment. Voltages and currents can be calculated also for circuits containing nonlinear as well as voltage- or current-controlled components (resistors, inductors, capacitors), diodes, bipolar n-p-n or p-n-p transistors, field-effect transistors with insulated gate and p- or n-channel. These calculations are based on the node method of circuit analysis and on numerical methods (Newton, Gauss, Euler) with a moving range of convergence. It is possible to extract automatically a circuit segment where the electrical conditions change fast enough and to confine the calculations to it. The programs are written in FORTRAN for digital computers such as the M-4030 or the Unified System YeS-1022, 1033 and do not contain any subroutines written in low-level language. References 11: 10 Russian, 1 Western.
[284-2415]

METHODS OF NONLINEAR CURRENT AND TEST SIGNALS IN PROGRAMMED DESIGN OF RECEIVER-AMPLIFIER DEVICES

BLINOV, P. P. and LANTSOV, V. N.

[Abstract] Programmed design of receiver-amplifier devices for stringent linearity requirements includes a thorough analysis and subsequent minimization of nonlinear effects. The mathematical apparatus of a Volterra functional series is a very expedient one: it can be implemented with use of test signals for recurrent calculation of transfer functions and with use of nonlinear current as excitation for recurrent solution of linear differential equations approximating a system of nonlinear ones. Calculations are based on the node method of circuit analysis and they yield coefficients of Taylor series expansions for nonlinear parameters, by involving vectors of nonlinear excitation current and corresponding transfer functions of successively higher orders. A convenient algorithm involving only second-order and third-order terms has been programmed in FORTRAN-4 for Unified System computers. Figures 1; references: 4 Russian.
[284-2415]

COMMUNICATIONS

COMPARATIVE EVALUATION OF DIGITAL SIMULATION METHODS FOR RADIO ENGINEERING
SYSTEMS

BYKHOVSKIY, M. A.

[Abstract] A method is proposed for numerical integration of nonlinear dif-
ferential equations describing the performance of radio engineering systems.
It is a constant-step method with recurrence relations between values of the
dependent variable in successive steps, it involves linearization and subse-
quent integration by the method of integrating multiplier with appropriate
approximations, and then solution of the resulting linear equations by con-
ventional methods. The error of this method is evaluated and, in the case of
wideband signals, is shown to be smaller than those of the Runge-Kutta method.
Successively less accurate in this case are the Adams method with extrapolation,
the Adams method with interpolation, and the trapezoidal method. Least
accurate and not recommended for analysis is the Euler method. This evaluation
is based on simulation of interference compensators and phase-type automatic
frequency control. Figures 2; references: 1 Russian.
[295-2415]

METHODS OF OPTIMAL PROCESSING OF SIGNALS SUBMERGED IN ARRAY OF BACKGROUND
INTERFERENCE

SOSULIN, Yu. G.

[Abstract] Reception and processing of signals appearing together with inter-
ference arrays is considered. It is not known a priori which interference
component distorts the useful signal and no special constraints are imposed on
the signal and interference models. Optimal processing algorithms are con-
structed for a Bayes detector and for a non-Bayesian detector, the state
variables on which the observed process depends being random or nonrandom

unknown parameters, respectively. Simpler quasi-optimal algorithms are then constructed for practical purposes, a typical situation being that of a signal sufficiently weak as not to affect significantly the estimation of interference components and state variables. A device which implements such an algorithm consists structurally of an interference compensator followed by a Gaussian receiver in one channel. Two such channels in parallel feed a maximum likelihood-ratio selector, with an interference analyzer also added in parallel, the output of the selector going to a threshold device which decides the presence or absence of a signal. The estimation process is demonstrated on a simple real situation where a deterministic signal appears together with an interference array consisting of white noise and one interference component. Figures 5; references: 7 Russian.
[282-2415]

INFORMATION-CONTENT ESTIMATOR FOR EFFICIENCY OF NONPARAMETRIC SIGNAL DETECTION

BEZGUZIKOV, V. P.

[Abstract] A criterion is proposed for estimating the efficiency of nonparametric signal detection algorithms and, on this basis, optimizing the latter. The mean quantity of information contained in the set of readings serves as such a criterion for testing hypotheses in order to establish the presence or the absence of a signal. This criterion is applied to the rank test and to extremum-statistic procedures. Tables 2; references: 6 Russian.
[282-2415]

EFFECT OF DEPARTURE OF SIGNAL FIELD FROM SPACE-TIME COHERENCE ON EFFICIENCY OF ATMOSPHERIC OPTICAL COMMUNICATION LINES

MILYUTIN, Ye. R. and YAREMENKO, Yu. I.

[Abstract] The efficiency of an atmospheric optical communication line is estimated in terms of the signal-to-noise ratio at the detector output and its dependence on space-time coherence of the signal field. The effect of departure from coherence is calculated by using space-time coherence functions of various orders so as to account not only for fluctuations in space, at an instant of time corresponding to "frozen turbulence" or average over the observation period, but also for fluctuations in time. Two methods of signal reception are analyzed comparatively on this basis, assuming a plane wave with

normally distributed random phase in an isotropic locally homogeneous turbulent atmosphere. For both methods of reception, with a heterodyne detector and by direct photodetection, the basic algorithm applies to the general case of an unmodulated optical carrier signal propagating through a turbulent atmosphere which distorts it. The algorithm is then extended to cover various modes of signal modulation: amplitude modulation, frequency modulation, phase modulation, and linear polarization modulation in the case of heterodyne reception, intensity modulation (ideal as well as real) and linear polarization modulation in the case of direct photoreception. Tables 1; references 10: 3 Russian, 7 Western (4 in translation).
[282-2415]

COMPONENTS, HYBRIDS & MANUFACTURING TECHNOLOGY

AMPLITUDE STABILITY OF SELF-EXCITED OSCILLATORS UNDER IONIZING RADIATION

D'YACHKIN, V. P. and KRASIL'NIKOV, S. N.

[Abstract] The effect of ionizing radiation on a self-excited oscillator with
automatic gain stabilization (AGS) by means of a reference attenuator is cal-
culated, a reference amplifier being much more susceptible to ionizing action
and thus less suitable for a radiation environment. The device is represented
as a combination of equivalent linear amplifier with positive feedback,
attenuator, and AGS transducer. The amplitude of oscillations changes under
radiation, owing to increments of the transfer ratios of all four components,
the amount of change or the amplitude instability being proportional to the
particle flux and to a factor characterizing the effect of radiation on the
transfer ratio of the linear amplifier. Figures 2; references: 6 Russian.
[295-2415]

COMPUTERS

UDC 621.382.8

COMPUTER SIMULATION OF CHARGE REDISTRIBUTION EFFECT IN ANALOG CHARGE-COUPLED
DEVICES WITH FLOATING GATES

KARAKHANYAN, E. R. and KAPERKO, A. F.

[Abstract] The charge redistribution effect in analog charge-coupled devices
with a floating gate is described on the basis of a structure where an analog
signal enters the diffusion layer on the input side and charge injection under
the floating gate occurs throughout the duration of a pulse at the control
electrode. The shielding electrode adjacent to the diffusion layer remains at
a fixed potential, while a decrease of the potential at the control electrode
causes redistribution of charge so that one part of it returns to the diffusion
layer through the shielding electrode and the remainder moves under the float-
ing gate. This effect determines the linearity of the device characteristics
and is simulated here mathematically by a partial differential equation of
continuity with appropriate boundary conditions which describe the motion of
charge carriers as a transient process. A relation is added for 1) The number
of mobile charge carriers as a linear function of the net voltage and for 2)
The electron current density as the sum of a drift component and a diffusion
component at any point on the semiconductor surface. The algorithm of simula-
tion involves transforming the equation of continuity into a difference equa-
tion and solving the latter according to the implicit scheme, taking into
account variation of the charge concentration gradient along the channel to a
maximum value at the interelectrode boundary. Calculations have been made for
a specific structure with typical values of parameters. Figures 4; references
5: 3 Russian, 2 Western (1 in translation).
[284-2415]

REAL-TIME OPERATIONAL SYSTEM FOR SERIES V7 CONTROL MICROCOMPUTERS

ALEKSANDROVSKIY, L. D., engineer, All-Union Scientific Research Institute of
Electromechanics

[Abstract] Two real-time operational systems have been developed for series
V7 control microcomputers. The RMS/80 multiproblem executor, functionally
similar to the RMX/80 (Intel Corp.), is a general-purpose system for high-
speed control. The SRV is a special-purpose one for control systems requiring
fast service. It features rather unique structures for presentation of
tables and lists, targeted for logic processing of binary data with less soft-
ware covering more functions. Its input-output subsystem operates in the
asynchronous mode, no physical interaction with the terminal being necessary
for solution of application problems. It has the same capabilities as the
RMS/80, except it cannot do "advance" data setting, and occupies only half the
memory volume. The SRV system is flexible so that its structure can be
tailored to suit any specific application and microcomputer configuration.
Tables 1; references 3: 2 Russian, 1 Western.
[292-2415]

COMPUTER-AIDED SELECTION OF MICROPROCESSOR TYPE

GLUSHANKOV, Ye. I., DAVYDENKO, V. V. and POLYAKOV, G. A.

[Abstract] Selecting the optimum microprocessor type as part of a given radio-
electronic apparatus can be facilitated by a computer. The selection is most
expediently based on a single criterion, cost being a typical one, with all
other determining parameters stipulated as constraints. The computer solves
the corresponding minimization problem according to the appropriate flow
diagram and with aid of a lookup table which lists available microprocessors
and their essential characteristics. The algorithm of microprocessor selection
on basis of the minimum-cost criterion has been programmed in PL/1 for a YeS-
1030 Unified System computer. Figures 1; tables 1.
[284-2415]

CONTROL SYSTEMS

AUTOMATIC PHASE CONTROL SYSTEM WITH DIGITAL CONVERTER FOR LINEARLY FREQUENCY-
MODULATED OSCILLATIONS

KOCHEMASOV, V. N.

[Abstract] Automatic phase control systems for linearly frequency-modulated
oscillations usually include a digital converter between the mixer and pulse
phase detector. The performance of such a system is analyzed in terms of the
relation between phase error in frequency-modulated oscillations and phase
error in converted pulse sequences. Calculations by the method of resultant
equations yield the dynamic characteristics, which can be largely improved by
means of a gain regulator. Such a system can operate with large initial
deviations from the linear law of frequency modulation. Figures 2;
references: 6 Russian.
[295-2415]

ELECTRON DEVICES

CHARACTERISTICS OF SUPERCONDUCTING COAXIAL TRANSMISSION LINE IN MILLIMETER
WAVE BAND

GAL'PEROVICH, D. Ya., LAPTEV, A. A. and KHRENKOV, N. N.

[Abstract] The frequency characteristics of a superconducting miniature coaxial
transmission line are calculated on the basis of two theoretical relations for
the frequency dependence of the attenuation coeffient at 4.2 K, namely:
α (dB/km) = $a_1 f^2 + a_2 f$ and α (dB/km)= $a_1 f^n + a_2 f^2$ (f- frequency in GHz, a_1-
coefficient proportional to the superconductor surface resistance and equal to
0.03-0.06 for niobium or lead, a_2 - coefficient proportional to the insulation
dielectric loss tangent and equal to 0.4-0.8 for Teflon-4D). The surface
resistance is also a power function of the frequency, the exponent decreasing
from n = 1.75 in the 20 GHz band to n = 1 in the 100 GHz band for niobium or
lead. Measurements in the 27-33 GHz band and in the 52-72 GHz band indicate
that a frequency close to 68 GHz is critical, beyond which the attenuation
coefficient increases sharply and the variance of readings becomes very wide.
On the basis of minimum losses, at the point of optimum matching, the data fit
the relation $\alpha = a_1 f^{1.3} + a_2 f^2$, with surface resistances and loss tangent given
frequencies calculated by the method of least squares. The authors thank
A. L. Solov'yev for performing measurements and V. A. Bystrov for helpful dis-
cussion of results. Figures 3; references 19: 8 Russian, 11 Western.
[295-2415]

SENSITIVITY OF MODEM-TYPE DETECTOR RECEIVER WITH SUPERCONDUCTING POINT JUNCTION

KOVALENKO, A. S.

[Abstract] A modem-type detector receiver with a superconducting point junc-
tion is considered for use in a radiometer, the junction serving simultaneously
as a radiation detector and step-up frequency converter with self-excitation.

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In the simplest form such a junction is not shunted at low frequencies and its
bandwidth is determined by natural fluctuations. The noise characteristics of
the instrument are calculated on this basis and its maximum sensitivity is
determined, the latter depending on the operating point as well as on the match-
ing of detector and amplifier. Figures 3; references 6: 5 Russian, 1 Western.
[282-2415]

ALGORITHM AND PROGRAM FOR CALCULATING FREQUENCY CHARACTERISTICS OF INTEGRATED
TRANSISTOR STRUCTURES DEPENDING ON THEIR TOPOLOGY

PETROSYANTS, K. O. and RYABOV, N. I.

[Abstract] A bipolar planar transistor as an element of large-scale integra-
tion is described by a small-signal model, namely a two-dimensional system of
linear partial differential equations of the elliptic kind with boundary condi-
tions for potential and current, as well as integral conditions for currents
through the regions. This model of the device allows for its fine-diffused
structure and varying intricate topology with attendant steady-state current
crowding toward the emitter periphery and modulation of electrical conductiv-
ities in base and collector regions at high frequencies. The algorithm for
calculating the frequency characteristics of such a device on this basis
numerically by the method of finite differences, with a difference grid super-
posed on the topological map for discretization of the equations, has been pro-
grammed in FORTRAN-4 for Unified System computers. Typical results are shown
which have been obtained with aid of a YeS-1022 computer. Figures 3;
references 6: 3 Russian, 3 Western.
[284-2415]

PASSIVE EQUIVALENTS OF TELEVISION TRANSMITTER TUBES

MIKHAYLOV-TEPLOV, N. N.

[Abstract] The resolving power of television transmitter tubes is usually
evaluated quantitatively by measurement of the percentage modulation on dashes
of a certain thickness (400 lines). The accuracy of these measurements
depends on the amplitude-frequency characteristic of the video channel, par-
ticularly that of the preamplifier. The latter is measured using a passive
equivalent of the tube with focusing-and-deflecting system. The error of this
measurement is analyzed here on the basis of the test circuit diagram, which
includes a variable capacitor adjusting for the difference between the trans-
fer capacitance of the passive equivalent and the total input capacitance of

the preamplifier. This error is determined by the frequency dependence of the internal impedance and the transfer capacitance of the passive equivalent, the latter ceasing to act as a current generator at high frequencies. The error can be minimized by making the internal impedance as high as possible, making the transfer capacitance a large part of the preamplifier input capacitance and thus negligible, and designing the preamplifier with an amplitude-frequency characteristic matching the frequency dependence of both parameters of the passive equivalent. For actual measurements it is most expedient to select a passive equivalent with a small output capacitance, not larger than 1 pF, and connect it directly to the preamplifier input without disconnecting the tube and the focusing-deflecting system. Figures 3; references: 4 Russian. [297-2415]

NEW INDUSTRIAL TRACTION SETS

DUBINA, I. Ya., director, Dnepropetrovsk Electric Locomotive Manufacturing
Plant

[Abstract] The second-generation industrial traction sets OPE1B and PEZT pro-
duced at the Dnepropetrovsk electric locomotive manufacturing plant include
interchangeable diesel compartments, dumpcarts, and trolleys. The twelve
motors are mounted for five different combinations of 12, 8, or 4 axles. They
are electrically connected in parallel for operation either with a contact rod
from overhead wires or from a diesel-driven synchronous generator on board, and
their field coils are connected in series for resistance braking. The OPE1B
motors operate from an a.c. line through a 10/1.9-0.45 kV transformer and an
a.c. to d.c. converter with four-zone voltage regulation by the thyristor-
angle method. The PEZT motors operate from a d.c. line through a 12-phase d.c.
to d.c. converter with smooth voltage regulation by the thyristor-pulse
method. This converter features a single magnetically coupled smoothing choke
coil per phase pair and a single commutator per pair of thyristor arms. When
the motors operate from an on board diesel-driven synchronous generator, vol-
tage regulation is effected by regulation of diesel engine speed and generator
excitation current. Each set of motors weighs 372 tons, can develop a starting
pull of up to 900 kN and a speed of up to 65 km/h, can negotiate a curve of 80
m radius at 10 km/h and a head grade of up to 8%. Both sets feature standard
pneumatic, diesel, and electrical appurtenances, including compressor drives
and adequate cooling. The engineer's cabin is wider than the cars, to provide
a complete field of vision. The sets have been tested through all seasons in
all parts of the Soviet Union (Europe, Siberia, subarctic region, Central Asia).
Figures 1; tables 1.
[292-2415]

ELECTRIC ORE HEATING FURNACES FOR PRODUCTION OF MINERAL FERTILIZERS

PEL'TS, B. B., candidate of technical sciences, All-Union Scientific Research
Institute of Electrical Heating Equipment

[Asbstract] Intensified application of chemical methods in Soviet agriculture
is aided by use of electrical furnaces for ore heating and production of
mineral fertilizers. Electrical furnaces of 80-100 MVA power are already in
operation and furnaces of 150-200 MVA power have already been designed. At
this time ore heating furnaces consume up to 8% of all electrical energy
generated in the Soviet Union. Yellow phosphorus is extracted from ores com-
ing from the Kara-Tau basin and containing 18-21% P_2O_5 with up to 8% insoluble
schist, whereupon it serves as basic material for production of mineral
fertilizers as well as detergents and nutrients, also orthophosphoric acid
and phosphorus salts. The 80 MVA furnaces for this process are energized from
110,000/650-500 V single-phase special-purpose transformers, they have appro-
priate electrical insulation and refractory lining resistant to aggressive
vapors and gases for operation at 700-800°C temperatures. Such a furnace is
hermetically sealed and built to ensure reliable operation of three electrodes,
self-annealing ones and 1700 mm in diameter, designed for this application on
basis of extensive mathematical and experimental model studies. The ore heat-
ing process with such a furnace is economical, consuming 14,00 kW/ton at a
power utilization factor of 0.86 and a time utilization factor of 0.812 in the
worst case of lean phosphorite ores. References: 5 Russian.
[292-2415]

ELECTRICAL EQUIPMENT FOR CRUDE OIL AND NATURAL GAS PUMPING STATIONS

RYABOV, V. Z., director, Lys'va Turbogenerator Manufacturing Plant

[Abstract] Equipment manufactured at the Lys'va plant includes synchronous
motors and induction motors for compressing, pumping, cooling of gases and
liquids in chemical industries (coal) and petrochemical industries (crude oil,
natural gas). The synchronous motors most widely used for driving compressors
are the general-purpose STD series and the explosion-proof series STDP covering
together 116 ratings and sizes from 630 to 12,500 kW. Their performance
characteristics (power factor, efficiency), external dimensions and weights
(with open-cycle or closed-cycle ventilation) are tabulated. These series are
compared with the ChTM series as well as with analogous series manufactured in
other countries, on the basis of efficiency and weight per kilowatt as func-
tions of power rating. The induction motors most widely used in the oil

industry are the submersible PEVD and PEDP series covering the 250-500 kW range. Altogether more than 10,000 motors with total capacity on the order of 40,000 MW are installed in order to cover the needs of the national economy. New models with ratings from 20 to 63 MW and with speed regulation from 0.6 to 1.2 nominal are being developed for extraction and transportation of oil and gas as well as for blast and open-hearth furnaces and converters in the metal making industry. Figures 4; tables 2.
[292-2415]

INSTRUMENTATION & MEASUREMENTS

MEASUREMENT OF MUTUAL SPECTRAL POWER DENSITY WITH AID OF ACOUSTOOPTICAL PROCESSORS

BOKOV, L. A., KRAKOVSKIY, V. A. and PUGOVKIN, A. V.

[Abstract] A two-channel acoustooptical processor, an analog of the Young interferometer, is considered for measurement of the mutual spectral power density of radio signals. Radiation from a laser at some wavelength and frequency impinges at some angle on a two-channel acoustooptical modulator, where it is diffracted by ultrasonic fields excited by the radio signals, whereupon an interference pattern is produced in the focal plane of a lens. The field equation for this device and the characteristic of the equivalent space filter serve as a basis for the measurement algorithm, which involves extraction of the mutual spectral power density of two wideband radio signals, and also for calculating the phase sensitivity of the device and estimating the measurement error. The method is accurate and suitable for high-frequency as well as microwave measurements with a large number of resolvable power spectrum elements. It has been proved out experimentally in measurement of the phase difference of microwave signals with a He-Ne laser as the radiation source and with an $LiNbO_3$ crystal (35° Y-cut) and an $LiNbO_3$ resonance plate in the modulator. The speed of measurements is essentially limited by the signal input time. Figures 5; references: 5 Russian.
[282-2415]

METROLOGICAL PROVISIONS FOR MEASURING PARAMETERS OF TERMINAL ELEMENTS IN COAXIAL WAVEGUIDES

BERKHOYER, A. L., GUTINA, E. M., KONDAKOV, Yu. V. and KHVOROSTOV, B. A.

[Abstract] The paper considers the present level and the prospects for development of the means for measurement of the parameters of the terminal elements of coaxial waveguides. USSR industry widely uses such waveguides with wave

impedances of 50 and 75 ohms and various cross sections. The most frequently used are waveguides with 16/6.95, 7/3.04 and 16/4.58 mm cross sections, in frequency ranges up to 7, 12 and 3 GHz. Various activities of the Siberian State Scientific-Research Institute of Metrology (SMIIM) are described. The institute, for example, creates and improves the metrological basis of the terminal element parameters of the above waveguies. The SMIIM also develops, produces and transmits to organs of the checking service individual examples of measuring lines which correspond to the first order for all three types of coaxial waveguides. References: 7 Russian.
[309-6415]

RADIO PENETROSCOPE WITH COMPENSATING ACOUSTIC CHANNEL

VIL'KOTSKIY, M. A., KNYSH, V. P. and SERGIYENYA, S. I.

[Abstract] In flaw detection in objects with high dielectric permittivity or a high degree of internal homogeneity the test signal passing through the body can be much weaker than the signal scattered by the surface so that the latter signal needs to be suppressed. A radio penetroscope is described which ꞏꞏꞏ includes an acoustic channel for compensating that signal. Electromagnetic waves generated by an oscillator pass through an adjustable phase shifter and, after having been modulated by low-frequency waves from an acoustic oscillator, proceed to a transmitter antenna which sends them to the inspection object. A receiver antenna picks up signals scattered by the surface of the object or inside it and sends them to an amplitude-phase meter, where both amplitude and phase are referred to the modulating low frequency and from where they are sent to the subtractor. Meanwhile acoustic waves from the low-frequency oscillator (modulator) are also sent to the inspection object through another transmitter antenna and, after having been scattered by the object, are picked up by another receiver antenna which sends them through a variable-gain amplifier to the subtractor. Full compensation in the subtractor is achieved by regulating the phase shifter and the amplifier. Figures 3; references: 4 Russian.
[295-2415]

PRINCIPLES OF CONSTRUCTION FOR STANDARDS FOR A UNIT OF LASER WAVELENGTH

TOROPOV, A. K.

[Abstract] Practical block diagrams and the necessary technical characteristics are presented for a state special standard for a unit of laser wavelength, as

well as operational standards for continuous and pulse performance lasers
which meet contemporary requirements. The compositions described, the prin-
ciples of construction and the functioning of standards for a unit of laser
wavelength assure a significant (approximately by one order of magnitude)
increase of the precision of reproduction of a unit of wavelength. Figures 3;
references 16: 10 Russian, 6 Western.
[309-6415]

CALCULATING INTERFERENCE MEASUREMENT ERRORS WITH NONPARALLELISM OF FABRY-
PEROT INTERFEROMETER MIRRORS

POMERANSKIY, A. A. and TOMASHEVSKIY, Yu. F.

[Abstract] The results are presented of an investigation of the distortions of
multiple wave interference patterns with nonparallelity of the mirrors of
Fabry-Perot interferometers. A method is described for calculating distor-
tions which makes it possible to obtain precise expressions and the approxi-
mate formulas following from them. The theoretical analysis described is
experimentally confirmed. The results obtained can serve as a basis for
determining the errors of interferometer measurements with the use of various
measuring devices. Figures 1; references 7: 5 Russian, 2 Western.
[309-6415]

SYMBOLIC ANALYSIS OF MICROWAVE DEVICES

KARPUKOV, L. M.

[Abstract] A method of symbolic analysis is shown which is applicable to
automated circuit design of electronic circuits. It is applied specifically to
linear circuits whose decomposition models can be made to appear as combina-
tions of regular transmission line segments and multipole networks with known
scattering matrices. The analysis proceeds in two stages. First the Cramer
rule is used for expanding the minors of scattering matrices of the circuit
into minors of the scattering matrices of the circuit components, then the
Jacobi theorem is used for transition from the latter minors to parameters of
the equivalent circuits. References: 5 Russian.
[284-2415]

COMPUTER SIMULATION OF TWO-FREQUENCY OPERATING MODES OF MICROWAVE OSCILLATOR
WITH GUNN-EFFECT DIODE

MASLOV, A. V. and FOMIN, N. N.

[Abstract] The steady-state performance of a microwave oscillator with a Gunn-
effect diode in two-frequency modes is analyzed on the basis of computer simu-
lation. For the autonomous case (self-excitation) the diode is described by a
biharmonic equivalent small-signal transfer function with both conductance
and susceptance consisting of a constant part and a part proportional to the
high-frequency voltage squared, while the tank circuit has a shunt LC branch
and a series LC branch each with a different sharp resonance frequency. In
this case, depending on the phase relations and the combination of circuit
parameter values, "synchronous" or "asynchronous" oscillations can be generated
when the resonance frequency of the series branch is equal or very close to
triple the resonance frequency of the shunt branch. The same model of a Gunn

effect diode is used for the nonautonomous case (external synchronization). In this case harmonic locking at the fundamental frequency results either in some attenuation of the fundamental mode and some enhancement of the spurious mode or complete suppression of the former with large enhancement of the latter. Third-harmonic oscillations increase the asymmetry of the synchronization characteristics and narrow down the fundamental-mode locking band. Figures 4; references 13: 10 Russian, 3 Western (2 in translation). [284-2415]

POWER ENGINEERING

ELECTRICAL ENGINEERING AND NUCLEAR POWER

GLEBOV, I. A., academician, USSR Academy of Sciences, director, All-Union
Scientific Research Institute of Electrical Machine Building

[Abstract] Since 1954, when the world's first nuclear electric power plant was
put into operation in the Soviet Union, generation of atomic energy has grown
to a level of 72.9 billion kW.h annually in 1980 and is projected to a level
of 225 billion kW.h annually (15% of all energy generated) by the end of the
11th Five Year Plan period. Two types of thermal reactors operate in the
Soviet Union today: two-loop water-moderated water-cooled ones and one-loop
multichannel graphite-moderated ones, a 1000 MW reactor of the former type
already operating with a single turbine-generator set and a 1500 MW reactor of
the latter type being built now with two 500-800 MW turbine-generator sets.
Turbogenerators for atomic electric power plants are basically hydrogen cooled
and designed for 24 kV and either 3000 or 1500 rpm, with efficiencies up to
98.8% and a specific weight of 0.5 to 0.6 kg/kVA. The power margin of conven-
tional turbogenerators can be improved by complete water cooling, as an already
built and tested 24 kV - 800 MW - 3000 rpm unit demonstrates. Atomic electric
power plants require a system of reactor control and safety assurance, the
most critical component of this system being the electric motor which moves
the neutron flux moderator in or out of the reactor core. Another important
component are fully automated diesel-generator standby sets for reliability
assurance. Fast reactors can be cooled either with gas or with liquid metal,
the former method requiring an adequate (6300 kW) vertical variable-speed (600-
6000 rpm) regulator motor. Further development of nuclear power will neces-
sarily involve not only the reactor but also electrical equipment, both general-
purpose standard and special-purpose devices throughout the power plant and
substations, for operation under extreme conditions (temperatures, pressures,
radiation).
[292-2415]

AUTOMATIC CONTROL SYSTEMS WITH MICROCOMPUTERS FOR ELECTRICAL EQUIPMENT IN POWER GENERATION INDUSTRY

BORTNIK, I. M., doctor of technical sciences, KOVALEV, V. D., candidate of technical sciences, and KORNILOV, B. A., engineer, All-Union Institute of Electrical Engineering imeni V. I. Lenin

[Abstract] Automatic control systems are being built for electrical power plant equipment in accordance with guidelines set forth by the CPSU Central Committee and the USSR Council of Ministers on automation. They include an automatic excitation regulator for synchronous generators and compensators, power controls for turbine-generator sets, automatic fault protection, automatic controls for technological processes in hydroelectric power and water storage plants, protection and automation for d.c. auxiliaries and transmission lines, control and regulation of static capacitors for power factor correction. Minicomputers for data processing and optimization of automatic control system performance are being replaced by microcomputers with appropriate interfacing in order to ensure reliability, accuracy, and fast response. Domestically manufactured microcomputer chips are not adequate for a closed control system, this problem being overcome by programming and use of several microcomputers with redundancy in a system for individual and general control. Software is written in assembler language and programs are debugged with the aid of simulators. Hardware is assembled in cabinets with universal modular structure for maximum standardization as well as to ensure proper interaction and matching of control system components. Figures 3; references: 3 Russian. [292-2415]

CALCULATION OF RELIABILITY INDICATORS FOR ELECTRICAL POWER SUPPLY SYSTEMS

FOKIN, Yu. A., candidate of technical sciences, Moscow Power Engineering Institute

[Abstract] In order to ensure continuity of electrical power supply in complex multidimensional systems, it is necessary to resort to models of statistically varying structures and estimation of power deficiencies to be covered by appropriate switching on the basis of reliability indicators. The calculation scheme is formulated so as to reflect not only the scheme of electrical circuit connections but also the logic of system functioning in case of faults, including all possible faults in the system elements. This is done by determining the minimum or fundamental sections relative to the electrical circuit of the system and then forming three matrices on a digital computer. These are

a matrix representing the set of elements connected to network nodes directly, a matrix representing the set of elements connected to network nodes through nonautomatic switches, and a matrix representing the set of elements connected to network nodes through automatic switches. Then nodes in fundamental sections are replaced by elements of those respective sets with corresponding reliability indicators, whereupon additional sections are obtained reflecting the logic of system operation. The algorithm of determining the sections relative to load points, with differentiation between fundamental and additional ones, can be accelerated by use of graphs. It involves determining the shortest path between power source and load point, checking the connectedness upon disconnection of each element along this path, and then determining successively the second, the third, and the fourth shortest path with, respectively, maximum possible disconnection of elements in the preceding shortest path. This algorithm is efficient when only one- and two-element sections are involved, becomes much less efficient with three-element sections. Subsequent reliability calculation must also take into account operational constraints in the system, and it includes the probability of fault cascading (calculated with aid of high-order initial-state matrices). The results of these calculations provide an adequate basis for system operation and control as well as emergency management. Figures 2; references: 8 Russian.
[294-2415]

ENCLOSED DISTRIBUTION DEVICES WITH GASEOUS ELECTRICAL INSULATION FOR 110-1150 kV VOLTAGES: STATE OF ART AND PROSPECTS

VISHNEVSKIY, Yu. I., candidate of technical sciences, TARASOV, V. K., engineer, BORIN, V. N., candidate of technical sciences, and CHEMERIS, V. S., engineer, "Elektroapparat" Production Association, Leningrad; and All-Union Institute of Electrical Engineering imeni V. I. Lenin

[Abstract] The main advantages of closed-construction distribution devices with gaseous electrical insulation are small size and material economy, and their suitability for complete component and assembly packaging in accordance with industrial methods applicable to substations. This is demonstrated by a comparison with analogous open-construction devices for voltage classes from 110 to 1150 kV in terms of surface area and mass. Closed-construction devices with gas insulation have been extensively developed and installed during the past decade. Further development is foreseen for applications where open-construction devices are unacceptable because of environmental conditions. These developments are targeted to meet specific performance requirements such as current carrying capacity, current breaking capacity, electrodynamic and thermal stability, and complete current breaking time, as well as to facilitate standardization. Test specifications have been established, according to which already available second-generation circuit breaker cells for 110 and 220 V voltage classes qualify. They are built to Interelektra (USSR, GDR, Poland, Czechoslovakia, Romania, Yugoslavia) specifications. Their characteristics are compared with those of similar devices manufactured by Brown Boveri Co and Siemens Co. Figures 6; tables 3; references: 4 Russian.
[292-2415]

SOVIET ELECTRICAL ENGINEERING INDUSTRY AT 'ELEKTRO-82' INTERNATIONAL EXHIBITION

[Abstract] The Soviet pavilion at the "Elektro-82" International Exhibition displays efforts and achievements which can be summed up by the slogan "electrical engineering for man's benefit." Activities of the Soviet electrical engineering industry represented at this exhibition include design, manufacture, and operation of large turbine generators for hydroelectric, thermal electric, and atomic electric power plants, development of new techniques for extraction and management of fossil fuels, for electrification of agriculture, and for environmental protection. Particularly interesting items exhibited here are a new deep-well oil drilling set with microcomputer control, the "Meteor-Priroda" weather satellite, the "Yenisey" automated air-plasma equipment for cutting up to 30 mm thick rolled strip (first one of this kind worldwide), and the EShP-80L electroslag casting furnace. Other Soviet exhibits cover a wide variety of industrial machinery and consumer appliances, as well as medical equipment. One part of the Soviet pavilion is devoted to "socialist economical integration in electrical engineering industry" in collaboration with other CEMA countries and Yugoslavia. Organizations within the council are developing complex programs of design automation and product standardization. Examples of accomplishments in this area are a new line of 200-1000 kW induction motors and a unique 30-ton electron-beam furnace. The Soviet electrical engineering industry collaborates not only with Polish, Czechoslovak and GDR manufacturing enterprises but also with over 20 companies in capitalist countries. All this should help everybody and ultimately further the quest for peace in the world. [292-2415]

NEW DEVELOPMENTS IN CABLE INDUSTRY

PESHKOV, I. B., doctor of technical sciences, director, All-Union Scientific Research Design-Engineering and Technological Institute of Cable Industry

[Abstract] During the 1975-80 period the design of cables has been improved in terms of metal economy and manufacturability, as well as for easier installation and maintenance. A typical example is 110 kV power cables with plastic

insulation replacing oil and with reduced per-unit metal (copper, aluminum, lead) content. Their allowable conductor operating temperatures are 90° continuous, 130°C during overloads for 100 h in one year and 1000 h in life of cable, 250°C momentary. Test voltages are 190 kV -50 Hz for 15 min, ten 550 kV pulses of both polarities and of 1.5/40-50 μs duration. The allowable current rating is 1.5-2 A/mm^2 under normal conditions, with allowable short-circuit currents of 25-30 kA for 0.1 s. The insulation has a loss tangent not larger than 0.001 at room temperature and 90°C. It consists of vulcanized polyethylene tape around the high-emissivity conductor coating and plastic compound around the outer metal shield. The design of cable termination and splicing sleeves deserves attention. Another development is use of optical quartz fibers with a refractivity gradient, for single-mode or multimode transmission, 6-10 fibers per cable for long lines (attenuation 5 dB/km, pass band 300-1000 MHz·km) and 2-10 fibers per cable for connections within or between devices (5-20 dB/km, 40-800 MHz·km). Another development is the use of ductile superconducting materials (alloys of niobium with Zr, Ti, Ta, compounds of niobium with Sn, Al, Ge, Ga, compounds of vanadium with Ga, Si) for ribbon conductors, transposed flat conductors, and grooved conductors (with circulating coolant) in single-conductor and multiconductor cables. In addition, automation systems for control of technological processes have been introduced in the manufacture of cables, a two-level system operating since 1980 in the production of insulated telephone cables on automatic assembly lines. This automatic control system is built on a modern microprocessor base with appropriate interfacing and in accordance with the hierarchical principle. It has improved productivity at a given quality level by 20-25%, with a corresponding decrease of rejects and shutdowns. Problems still to be resolved are those of predicting cable life, which depends largely on the polymer characteristics. Research in this area involves correlating theoretical results based on kinetic equations of physical processes such as aging and on temperature-time extrapolations with actual data on the plastic material and its operating parameters.
Figures 6; tables 2.
[292-2415]

MULTICHANNEL PHOTORECEIVERS FOR OPTOELECTRONIC MEMORY

GUSEV, V. K., ROSLOVA, M. L., FEDOROV, V. B. and SHILOV, I. A.

[Abstract] Design of multichannel photoreceivers for holographic memories and optoelectronic computer storages is examined from the standpoint of largely contradictory requirements imposed by the structure of the data array and the characteristics of optical signals. The main requirements are a large aperture and high sensitivity, per unit useful area and per unit angular aperture, in order to match a large memory capacity and at the same time ensure adequate noise immunity. Other requirements are a fast read and short transients, especially during erasure. The sensitivity is limited by fluctuation noise, which includes thermal noise in signal currents and in dark currents as well

as in switching, code-dependent time interference (process history) and space interference (parasitic couplings between channels), interference due to non-identicality of structural elements and inhomogeneities in them, interference due to pickup, background noise, temperature changes and other changes. Most promising for practical use are multichannel photoreceivers comprising MOS photodiode cells with two MOS transistors per photodiode and those comprising light-sensitive triggers with either MOS or bipolar transistors. The change in sensitivity increases with an increasing number of elements and depends nonmonotonically on the photodiode bias voltage, reaching a minimum at approximately 3.3 V. The change in sensitivity can be maintained small throughout the range of bias voltages by means of automatic sensitivity tuning. These versions of multichannel photoreceivers perform in every respect better than those based on hybrid electron-optical converters with semiconductor target and beam deflection system. Problems in their design arise during conversion from discrete photodiodes to integrated-hybrid arrays, requiring special techniques and algorithms. Figures 6; tables 2; references 28: 17 Russian, 11 Western (1 in translation).
[295-2415]

MAXIMA OF CROSS-CORRELATION FUNCTIONS FOR M-SEQUENCES

MIKHAYLOV, V. Yu.

[Abstract] The maximum swings of cross-correlation functions for M-sequences of $N = 2^{2p} - 1$ symbols are calculated by a method which utilizes the algebraic properties of such a sequence and of the field of its elements. The method involves expanding elements of field $GF(2^{2p})$ into elements of subfield $GF(2^p)$ and is applicable to any p, even or odd. The method also facilitates search for "bad" pairs, for the purpose of their elimination from the ensemble. Tables 2; references: 6 Russian.
[282-1425]

1981 USSR STATE PRIZE IN ELECTRICAL ENGINEERING

[Abstract] The 1981 USSR State Prize in Electrical Engineering was awarded to 1) Coworkers of the Moscow Power Engineering Institute--Boris Alekseyevich Ivobotenko, dr of technical sciences, professor; Nikolay Fedotovich Il'inskiy, dr of technical sciences, chief of department; Georgiy Ashotovich Melkumov, candidate of technical science, senior scientific-research workers; Dmitriy Vasil'yevich Solomakhin, candidate of technical sciences, director of experimental plant; 2) Workers of the Design Bureau of Precision Electrical Machine

Building--Vasiliy Aleksandrovich Zen'kovich, chief of department; Anatoliy
Vladimirovich Yarosh, chief of department; Yuriy Fedorovich Lyashchuk, chief
of laboratory; Yevgeniy Vladimirovich Filippovich, leading designer; Yevgeniy
Ivanovich Belyavskiy, leading engineer; Aleksandr Antonovich Bulayev, chief
engineer of plant; 3) Aleksandr Afanas'yevich Sazonov, dr of technical
sciences, chief of department, Moscow Institute of Electronic Techniques;
Elizbar Semenovich Goniashvili, candidate of technical sciences, dotsent
Georgian Polytechnical Institute imeni V. I. Lenin. This prize was awarded for
efforts in developing a new principle of programmable synthesis of intricate
and precise movements of servo components for an electric drive which meets
the most stringent technical requirements in various modern applications, with
memory and microprocessor included in the modular structure. The basic parame-
ters are velocity up to 1 m/s, acceleration up to 50 m/s^2, force up to 100 N,
specific force 1-1.5 N/cm^2, position error $\pm$ 5 micrometer in simplest version
without feedback. The most outstanding are the achievements in the design of
electronic machinery components. Use of this equipment has increased labor
productivity in several basic technological operations by a factor of 5-10,
as well as the annual production volume with a better product quality and
reliability.
[267-2415]

GERMAN DEMOCRATIC REPUBLIC AT THIRD 'ELEKTRO-82' INTERNATIONAL EXHIBITION IN
MOSCOW, 13-27 JULY 1982

Moscow ELEKTRONTEKHNIKA in Russian No 6, Jun 82 pp 62-63

[Abstract] At the Third "Elektro-82" International Exhibition in Moscow,
13-27 July 1982, the German Democratic Republic will present electrical and
electronic equipment which it exports to the Soviet Union in accordance with
trade agreements and under auspices of responsible export-import organizations.
The two most interesting items are the ROBOTRON EC-1050 electronic data pro-
cessing system and the high-(pulse) voltage (1.6 MV) test stand, the latter
built at the "Hermann Matern" (Dresden) transformer and x-ray equipment manu-
facturing plant. Other items on exhibit have been produced in the German
Democratic Republic at its "Otto Buchwitz" (Dresden) high-voltage transformer
and distribution equipment manufacturing plant, Sachsenberg electrical
machinery manufacturing plant, "Ernst Taelmann" (Magdeburg) heavy machinery
manufacturing plant, "Wilhelm Pieck" (Oberspree) cable manufacturing plant,
and Teltow instrument manufacturing plant. Figures 2.
[292-2415]

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